every stage of manufacture, from the unshaped block to the finished *hâche*. There are the flint cores and the flakes lying beside them, there are flint hammer-stones and anvils, punches and scrapers, and other implements broken in various stages of manufacture. Very few of the latter are finished. They would, of course, be carried off for use, as was the case with those of the palæolithic floor discovered some ten years ago, in the brickpit at Crayford, by Mr. Flaxman Spurrell. Mr. Smith, we may remark, has followed the example of the latter, in the infinite pains he has taken to build up the original forms of the flint blocks from the broken implements and splinters. It is clear that in this place we have the workshop in the condition in which it was left by the palæolithic hunter. The fact that no bones and no charcoal have been discovered, shows that the palæolithic huts were some little distance away, and that this spot was selected solely for the purpose of implement-making.

The association of the ruder with the more finished of the palæolithic implements in this floor, as in the case of many of the palæolithic caverns, proves that an appeal to rudeness of form as a test of age, is a wrong principle. That man must have learnt first of all to make the simpler before he made the more complex implements, is so obvious, that it has never been disputed. The ruder, however, were used side by side with the more finished, and many of those forms which are taken to be of pre-palæolithic age in the gravels of the Kentish plateau are the necessary result of the working of the flint block into the palæolithic *hâche*. We may remark, further, that some of these are also found in the refuse-heaps round the old flint-mines of Cissbury, and have been made in the manufacture of neolithic implements.

In the introduction, Mr. Smith deals with the general question of the relation of palæolithic man to the glacial period, and concludes, rightly in our opinion, that man inhabited south-eastern England after the glacial period. We also agree with him in looking at the pre-glacial or post-glacial age of man as merely of local significance, because the glacial period is a purely local phenomenon not marked in the warmer southern lands, such as the Indian peninsula, which was inhabited by the palæolithic hunter. We know of him in India simply as living in the pleistocene age. He probably invaded Europe in the pre-glacial age, and lived in the south while Britain lay buried under a mass of glaciers, or was covered by a berg-laden sea. He is post-glacial in the valley of the Thames. He is not separated from our own times either by a wall of ice—one of the ice periods of Prof. James Geikie—or by the tumultuous waters of a vast deluge, such as that recently put before us by Sir Henry Howorth. He is separated by a geographical revolution during which the seaboard of north-western Europe, as we find it now, came into being, and Britain became an island—as well as by a change in our land from a continental to an insular climate.

The author also touches the difficult problem of the physique of primeval man, and he accepts the "type de Canstadt" as the earliest palæolithic race. This is, however, founded on a human skull which M. d'Acy has conclusively proved to have no claim to any definite age. According to the evidence of the catalogue, still preserved, of the pleistocene mammalia found at Canstadt in 1700, it was not found along with them. Dr. Reissel, who superintended the exploration for the Duke of Würtemberg, wrote in 1701 that no human remains were then found, "inter quæ tamen nulla humanis possunt comparari." Some fifty years later Dr. Albrecht Gessner, writing on the discovery, remarks that it is strange that no human remains had been met with. Both these were doctors to the Dukes of Würtemberg, and can only be supposed to know a human skull when they saw it. It was not until 1835 that the skull in question was found by Dr. Jaeger, in the Museum at Stuttgart, and assigned without proof of any kind to the find made 135 years before. It is very unfortunate that such faulty evidence as this should not only be accepted by the authors of "Crania Ethnica," but also used for the definition of the type "de la plus vieille des races humaines." In the present unsatisfactory state of the inquiry into the physique of palæolithic man, the only safe course is to subject all the facts which have been recorded to the most searching criticism, and to wait for the further light which will come sooner or later from new discoveries. In this small and well-illustrated monograph, Mr. Smith has made our knowledge of the palæolithic workshop more definite than it was before, and has collected together a mass of information which will be of great service to the archæologists of London.

W. BOYD DAWKINS.

THE SEQUENCE OF STUDIES.

Physiology for Beginners. By Professor M. Foster, M.A., M.D., F.R.S., and Lewis E. Shore, M.A., M.D. (London: Macmillan and Co., 1894.)

Outlines of Biology. By P. Chalmers Mitchell, M.A., F.Z.S. (London: Methuen and Co., 1894.)

Practical Methods in Microscopy. By C. H. Clark A.M. (Boston: Heath and Co., 1894.)

THE scientific precision and modernness of a book of elementary physiology, written by Dr. Shore, under the supervision of Prof. Foster, is scarcely to be called in question. This little volume is amply illustrated, and written with clearness as well as exactness. The authors are especially to be commended for laying stress in their preface upon the necessity of a preliminary acquaintance with Chemistry and Physics, and it is to be regretted that they had not the courage to insist upon this point. But here they are gravely open to criticism. "Knowing," they say, "how frequently a book on physiology is taken up without any such previous acquaintance, we have given a few chemical and physical facts as preliminaries in chapter i." A few, and quite too few, it is—six complete pages—expanding scarcely any of the principles which are involved in the simplest physiological explanation, giving, of course, no conceptions of the relations of chemical combination to energy, nor of osmose, diffusion, solution, isomerism nor the action of ferments, all of which come to the front directly one approaches respiration or digestion. We cannot but think that this concession to a common educational error is greatly to be deplored. The authors occupy a position of authority, and it was their privilege—a privi-

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lege they have neglected—to demand here, by assuming a sound basis of chemical and physical knowledge, the proper sequence of studies. As it is they have produced a little primer that by virtue of its clearness and attractiveness and the prestige of their names, will serve to uphold for a few years longer a fundamentally faulty system of scientific education.

The evil of a neglect of the rational sequence of studies becomes particularly apparent in the chapters upon the eye and ear. In the former of these an attempt is made to convey all the optical principles involved, in seven lines—"convex lens" is not even defined—and in the latter comes a series of dogmatic statements about sounds and noises, without a particle of that progressive reasoning process which is the very essence of genuine scientific study. Once the initial concession was made, however, this kind of thing was an inevitable consequence. In order to explain the science in hand, three or four others have to be compressed to the limits of a paragraph.

The same unfortunate disposition to begin the wrong way about is apparent in the little book by Mr. Chalmers Mitchell. But in his case there is even less excuse. His book is designed to prepare students for the Conjoint Boards Examination, and therein he is an examiner. Since he calls the tune he might have danced as he liked, and he has, we conclude, preferred of his own free will to contravene the common-places of educational science. We find such a proposition as the following, printed in spaced type; so that the medical student, preparing for examination by Mr. Chalmers Mitchell, who fails to learn it by heart will have only himself to blame for his failure. The earthworm, we are told,

> "has reached the second stage of cœlomate development in that it is very highly segmented, and there is little or no trace of the third stage, the stage of the condensation of segments." . . . "Vertebrates are highly segmented animals, in which condensation of segments has become an important factor, resulting notably in the formation of a complicated head, and of kidneys formed by the aggregation of many nephridia."

Now these propositions are illustrated rather than supported by a brief description of the anatomy of the earthworm, dogfish, and frog, and we find that even in the case of these types the metameric segmentation of the cranial nerves is scarcely alluded to, and the homology of the mandibular arch with the branchial bars is not presented as a probability, but stated as a fact. And, in brief, Mr. Chalmers Mitchell, who is not a crammer, but a teacher, gives the medical student the impression almost in so many words—"cut and dried" and ready to be cast into the oven—that the vertebrate type is merely a concentrated derivative (concertina fashion) of the chætopod type, advancing this pure, and as he gives it, baseless, speculation, in the face of the absence of any chætopod stage in the embryology or palæontology of the vertebrates, in the face of the lesser metamerism in the vertebral column of more primitive fishes, and in the face of the declared opinion of many prominent anatomists. But whether the view he gives is right or wrong is, from our point of view, the smaller issue; the great and grave objection is the unscientific spirit of the presentation, the narrowness of the base of anatomical fact upon which this far-reaching generalisation is raised. We find this disposition to what is really the old theological trick of dogmatism, again and again in his book, and it is the evident and necessary consequence of an attempt to touch the far-reaching theories of comparative anatomy without a sufficient preliminary study of individual types.

It is odd that we should find another aspect of the same mistake cropping up in one chapter of Mr. Clark's extremely useful and well-arranged handbook for the beginner in microscopy. It is in almost every way a well-arranged and well-written work, and will be particularly a boon to the amateur to whom experienced advice is inaccessible. But before proceeding to the petrographical instrument, Mr. Clark has attempted a "concise description" of polarised light, which begins—

> "The elasticity of the ether in space is believed to be equal in all directions. The same is true of the ether in non-crystalline substances and in crystalline substances of the cubical system. The particles of ether are consequently free to vibrate equally in all directions. In other crystalline substances the elasticity of the ether is modified by the crystalline structure. In some crystals there is one axis or direction about which the molecules are arranged in a uniform manner; such crystals are said to be uniaxial. In other crystals there are two such axes."

Now we believe a student who will clearly understand this will be sufficiently advanced not to require it, and that to the raw beginner, this passage, and its context, will be incomprehensible. Were it not for the actual evidence of these books it would seem the most unnecessary thing in the world to assert that a clear working idea of the *theory* of polarised light, or the general ideas of chemistry and physics, or a cyclopædia of the anatomy of the metazoa, cannot be imparted in half a dozen pages or so of text. If it could, our text-books in these subjects would be unnecessary, for the ultimate aim of all intelligent research and teaching in pure science is broader and simpler general notions, and there can be no need for a volume if a handbill will suffice. Cannot the scientific writer insist upon the proper sequence of studies in his preface, and proceed on the assumption that his counsel will be observed? To positively encourage students to proceed to subjects for which they have not the necessary grounding, to proffer them snap-shot chapters upon these neglected preliminaries, is really, we are persuaded, to place a grave impediment in their way to genuine knowledge, all the graver because it seems a help, and to place one also in the way of our advance towards more efficient science teaching in the future.

H. G. WELLS.

OUR BOOK SHELF.

Climbing and Exploration in the Karakoram-Himalayas. By William Martin Conway, M.A., F.S.A., &c. Containing Scientific Reports. (London: T. Fisher Unwin, 1894.)

THIS supplementary volume contains reports on the scientific results of Mr. Conway's adventurous journey, with his map of the mountain region between Rakipushi and Golden Throne, through which he travelled. The author supplies a list of measured altitudes and notes on the map, mentioning the differences from that of the Trigonometrical Survey of India. Lieut.-Colonel A. G. Durand describes the ethnology and later history of the

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